

synonymy of a species is given, but otherwise a reference to Cotes and Swinhoe's Catalogue of the Moths of India is substituted.

Touching the sinking of many described forms to the rank of synonyms, doubtless considerable differences of opinion will exist amongst lepidopterists; Mr. Hampson has used his private judgment in the matter, and, as an experienced collector of Indian Moths, his opinion must be allowed to have some weight. Without doubt the reduction of spurious species was much needed; but nevertheless the decision of no one man, however trustworthy, can be considered as final, until the life-history of many more species has been studied; because it is an acknowledged fact that, whereas some families of Moths are remarkable for their variability, others are almost as constant in all their characters.

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MISCELLANEOUS.

New Observations on the Affinities of the different Groups of Gastropods (Expeditions of the Yacht 'Hirondelle'). By M. E.-L. BOUVIER.

GASTROPODS are divided into two groups according as they are *unisexual* or *hermaphrodite*; the former (Prosobranchia) are further characterized by their decussating visceral commissure in the form of a figure of eight, while the latter (Opisthobranchia, Pulmonata, Pteropoda) are distinguished by their visceral commissure being more or less free from torsion. After a previous study* I had succeeded in partially removing the abnormal hiatus which an incomplete investigation had allowed to exist between these two groups, which I remained convinced must formerly have been united by a transitional form. If this form still existed it could only be found among the oldest Opisthobranchia, the Actæonidæ, which made their appearance in the Carboniferous period, and which are represented at the present time by the genus *Actæon*, of Triassic origin. Investigations which I have made upon specimens of *Actæon solidulus*, kindly handed over to me by M. Jousseàume, show that this Gastropod is, as a matter of fact, an ideal transitional form not only between the Prosobranchia and the Opisthobranchia, but also between the latter and the Pulmonata. As I have already published a succinct *résumé* of the organization and affinities of *Actæon* †, I shall here confine myself to an exposition of the general considerations to which the organization of this animal gives rise.

* "Quelques observations anatomiques sur les Mollusques gastéropodes," Comptes rendus de la Société de Biologie, December 17, 1892.

† Société philomathique, séance du 24 décembre, 1892, and Société de Biologie, séance du 7 janvier, 1893.

The nervous system of *Actæon** is decidedly chistoneurous, like that of the Prosobranchia. The commissural ganglion on each side is fused with the corresponding cerebral ganglion. One of the branches of the visceral commissure starts from the left cerebro-commissural ganglion, travels obliquely from left to right and from front to rear, passing beneath the long buccal mass, and ends in the subintestinal ganglion, which is situated to the right close to the body-wall; the other branch is detached from the right cerebro-commissural ganglion, travels from right to left and from front to rear above the buccal mass, and ends in the supra-intestinal ganglion. Starting from this ganglion, which is situated upon the body-wall to the left, the commissural branch passes backwards, and, shortly before reaching the anus, inclines to the right above the œsophagus, and terminates in the visceral ganglion, which lies between the latter and the oviduct. In this same ganglion likewise terminates the prolongation of the subintestinal branch.

The supra-intestinal ganglion innervates the gill and the left portion of the mantle; the subintestinal ganglion emits a nerve which proceeds to the right portion of the latter organ. The innervation of the mantle is, however, a little further complicated, owing to the presence of two small accessory ganglia, which we may term *secondary pallial ganglia*, and which are the more important since they will enable the chistoneurous nervous system of *Actæon* to transform itself by degrees into an orthoneous system. The first of these ganglia is situated upon the subintestinal branch, midway between the left cerebro-commissural ganglion and the subintestinal ganglion; it innervates the left portion of the mantle: the second is found upon the supra-intestinal branch, in the immediate neighbourhood of the right cerebro-commissural ganglion; it innervates the right portion of the mantle. Thus the left portion of the mantle receives at the same time the nerves of the supra-intestinal ganglion and of the left secondary pallial ganglion, while the right portion is innervated by the subintestinal ganglion and the right secondary pallial ganglion.

From the foregoing it is clear that *Actæon* is directly connected with the Prosobranchia, and, if we take into consideration the characters of the bipectinated gill, with the diotocardiac division of the latter. We now have to consider by what process it has been possible for them to give rise to orthoneous descendants, that is to say to the other Opisthobranchia and to the Pulmonata.

It has been shown by Bütschli that it would be possible to derive the Gastropoda from a dibranchiate primitive form, the two gills of which would have been situated symmetrically *behind*, the one to the right, the other to the left of the anus; this primitive form had

* Our knowledge of the nervous system of *Actæon* is based upon a figure by M. Pelseneer ('Challenger' Pteropoda, pl. ii. fig. 11). The cerebral and pedal centres are distinctly shown, but the visceral commissure is incompletely figured; however, it is merely a repetition of the scarcely twisted commissure of the normal Tectibranchia.

an orthoneurous visceral commissure, upon which we may imagine, to be concise, two symmetrical pallio-branchial ganglia, innervating symmetrically the gill and the mantle of the same side. The whole of this symmetrical apparatus has been transported, owing to the peculiar mode of growth, to the right and towards the front, and has finally come to occupy a symmetrical dorsal position, as we still find it in *Fissurella*. The primitive right gill is therefore found to the left, and the left to the right; moreover, since the gills carry with them the ganglia which innervate them, the visceral commissure became chistoneurous. Later on the right gill (primitive left) atrophied, and Gastropods were produced provided with the single left gill (primitive right) such as we find in the great majority of the Prosobranchia and also in *Acteon*.

But then there took place a displacement of the gill in precisely the opposite direction. The persisting left gill returned towards the rear and to the right, carrying with it its ganglion (the supra-intestinal) and the supra-intestinal commissural branch, which came to lie on the right side of the œsophagus.

The branchial ganglion (primitively supra-intestinal) probably became fused with the right secondary pallial ganglion; it no longer sent nerve-branches into the left portions of the mantle, which were too far off, but it innervated the regions of this organ which are situated to the right, that is to say in the neighbourhood of the gill. The subintestinal ganglion, having become useless, atrophied altogether, at the same time as was developed the left secondary pallial ganglion, which carried to the left of the œsophagus the subintestinal commissural branch, and assumed the sole control of the innervation of the left portions of the mantle (*Acera bullata* and aquatic Pulmonata). In the other Opisthobranchiate forms the left secondary pallial ganglion has approached much nearer to the visceral ganglion or has even become fused with it. In all cases the visceral commissure has become more or less decidedly orthoneurous, and this arrangement has enabled the nervous centres situated upon the commissure to approach one another very nearly, and even to fuse together (Nudibranchia, certain Pteropoda, and terrestrial Pulmonata). The Pulmonata are directly connected with the Actœonidæ by their branchiferous (*Siphonaria*) and operculate (*Amphibola*) species, and there can no longer be any question of establishing in the class Mollusca two parallel series independent one of the other.—*Comptes Rendus*, t. cxvi. no. 2 (January 9, 1893), pp. 68-70.

On the Branchial Sense-Organs of the Patellidæ.

By Dr. J. THIELE, of Dresden.

When I was examining some time ago a series of transverse sections which I had prepared of a specimen of *Patina pellucida*, my attention was attracted by a button-shaped projection of the epithelium at the sides of the body between the foot and mantle which could hardly be anything else than a sense-organ. For the moment